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Hafner et al.

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[54] **ROLLER PRESS WITH A DEVICE FOR THE RELIEF OF THE PRESSURE ROLL**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[4] **B30B 15/16**

[52] **U.S. Cl.** ..... **100/47;** 72/245; 100/50; 100/53; 100/163 A; 100/170; 162/360.1

[58] **Field of Search** ..... 100/47, 48, 50, 53, 100/155 R, 117, 158 R, 163 A, 159, 160, 161, 162 R, 168–170, 172, 173, 176, 267 R; 72/245, 243; 162/360.1, 271, 361; 137/87, 115, 117

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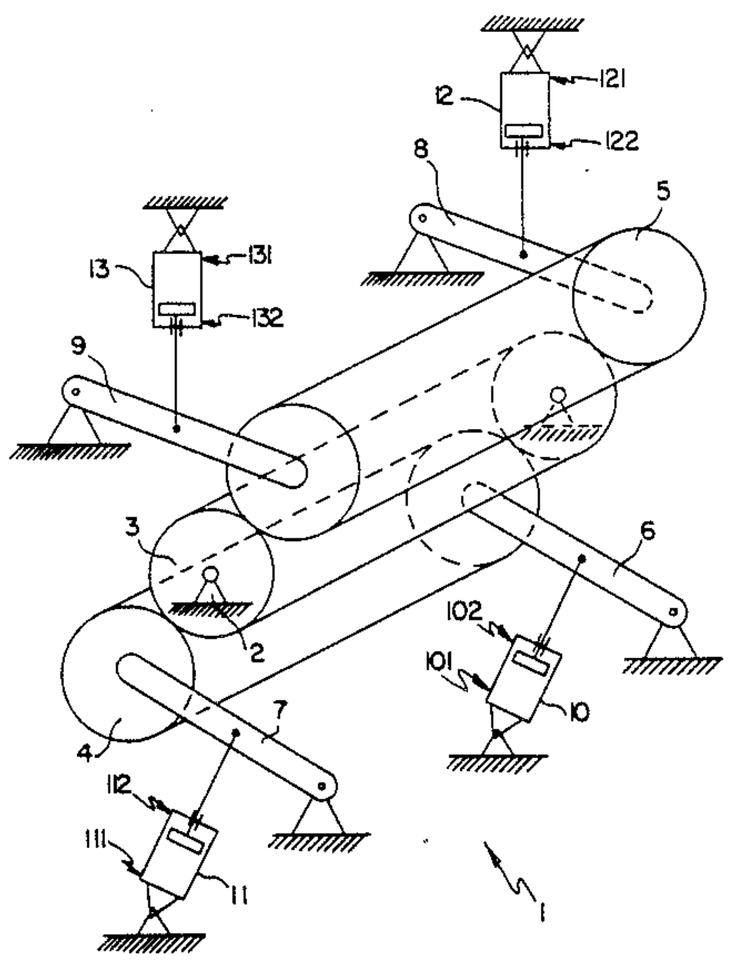
[57] **ABSTRACT**

A roller press has a press roll and at least one pressure roll applying pressure to it. In the end region of each pressure roll, there is an associated positioning cylinder. The positioning cylinders relieve the pressure of the pressure roll against the press roll automatically upon an impermissible increase in the operating pressure in the positioning cylinder. For this purpose, each positioning cylinder has a safety valve which is operated either by the working fluid in the positioning cylinder to the pressure relief condition or by an electrical signal, in different embodiments, to relieve pressure in the positioning cylinder. The safety valves are coupled to each other by a signal line. When one safety valve relieves one positioning cylinder, all of the positioning cylinders are relieved. Details of the working fluid operated safety valves and of the electrically operated safety valves are disclosed, including details of the valve body and the application of pressures upon the valve bodies which causes them to shift.

15 Claims, 4 Drawing Sheets



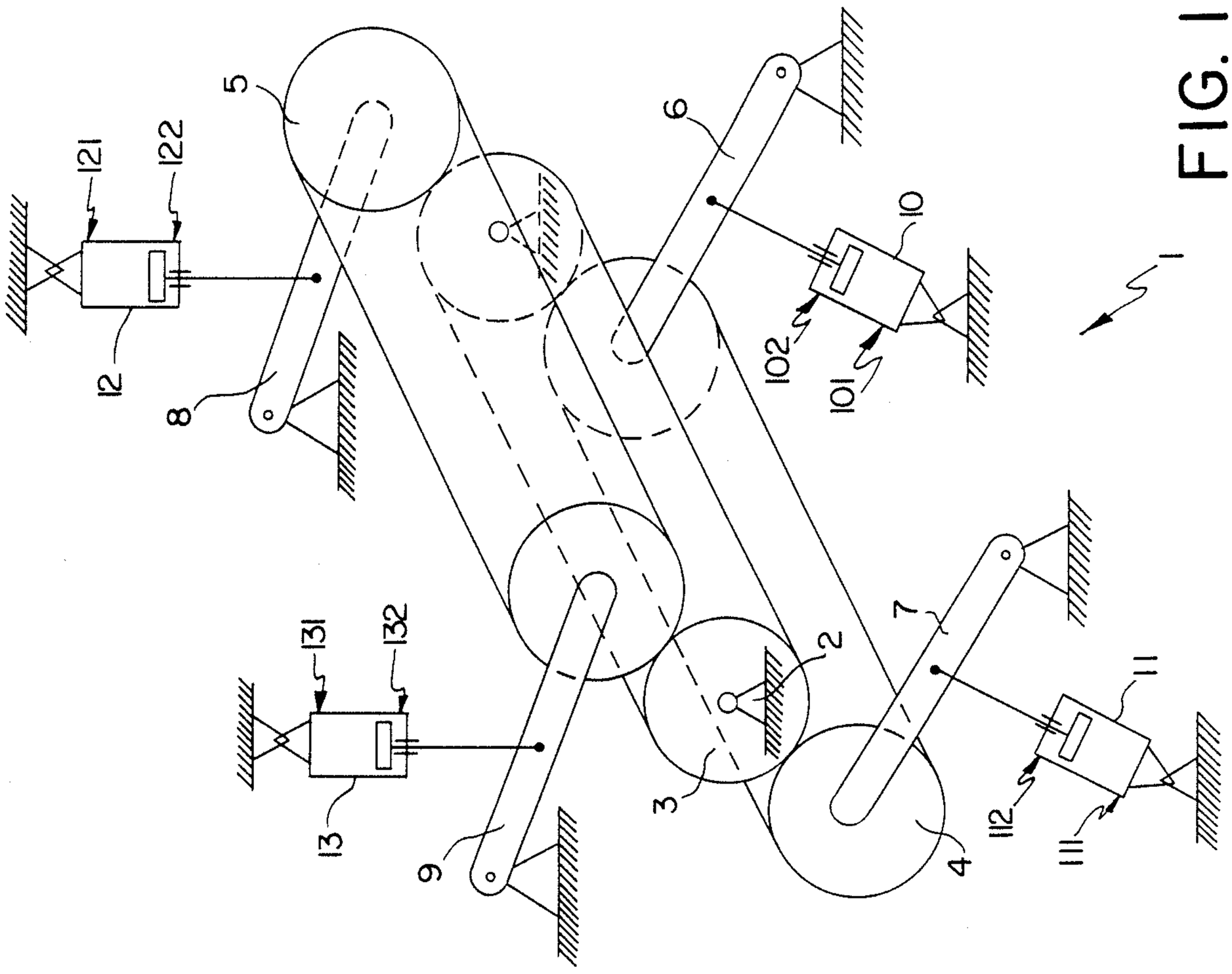
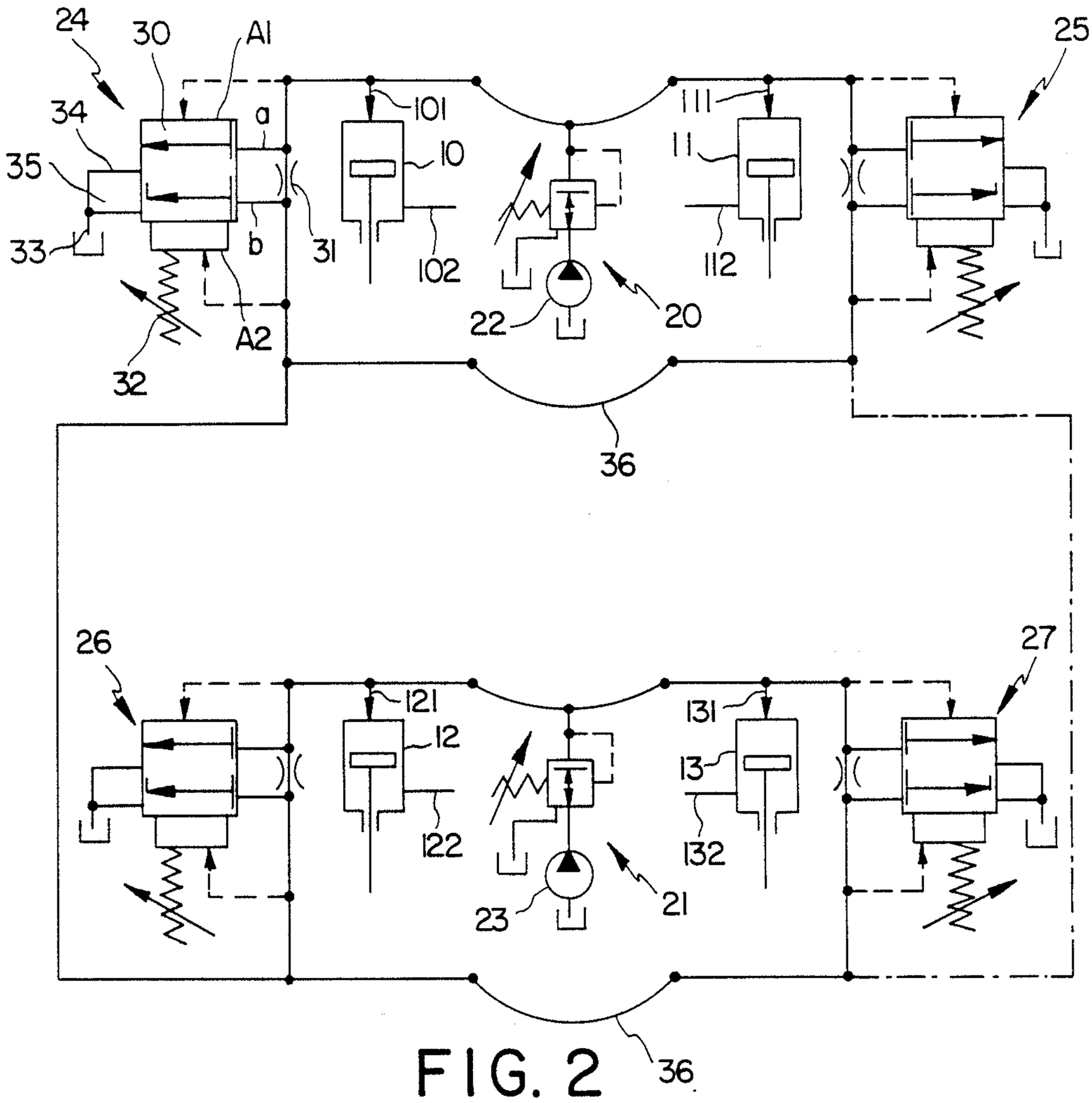


FIG. 1


24
30
A1
25
34
a
101
111
10
11
35
31
33
b
102
112
A2
32
22
20
36
26
27
121
131
12
13
122
132
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21
36

FIG. 2

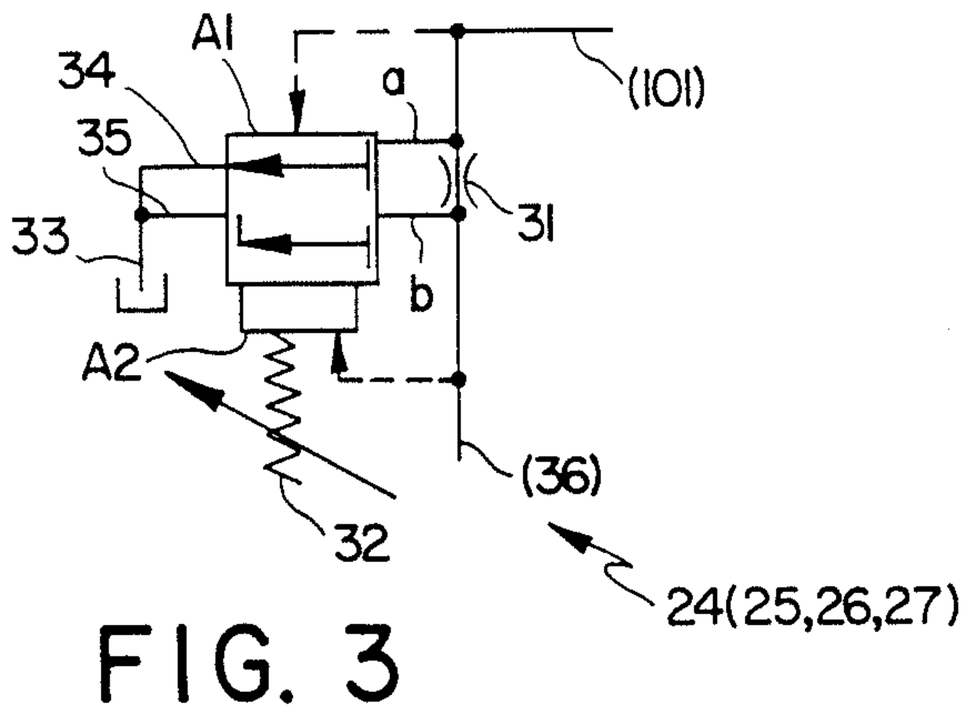
A1
34
a
(101)
35
31
33
b
A2
(36)
32
24(25,26,27)

FIG. 3

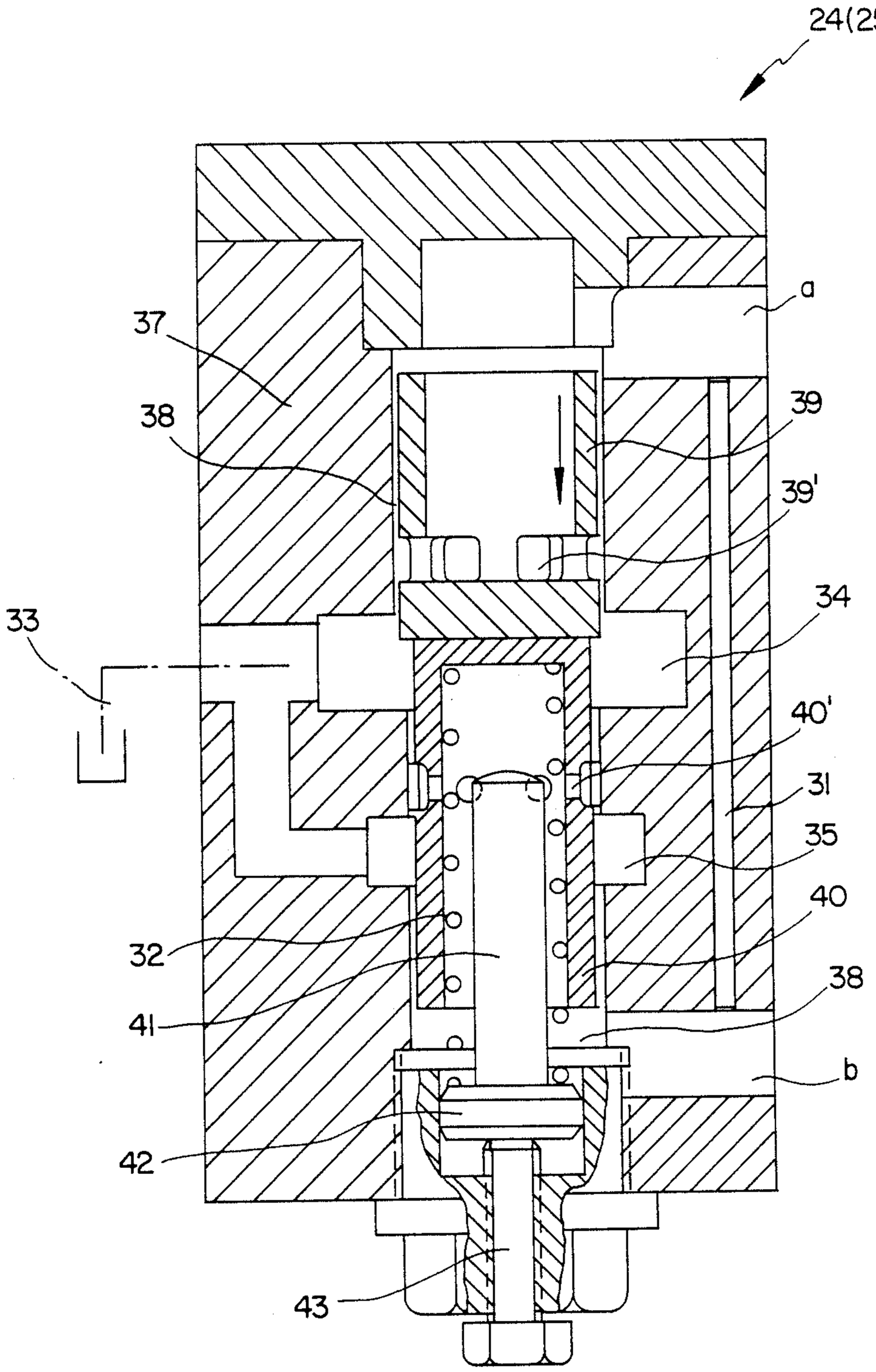

FIG. 4

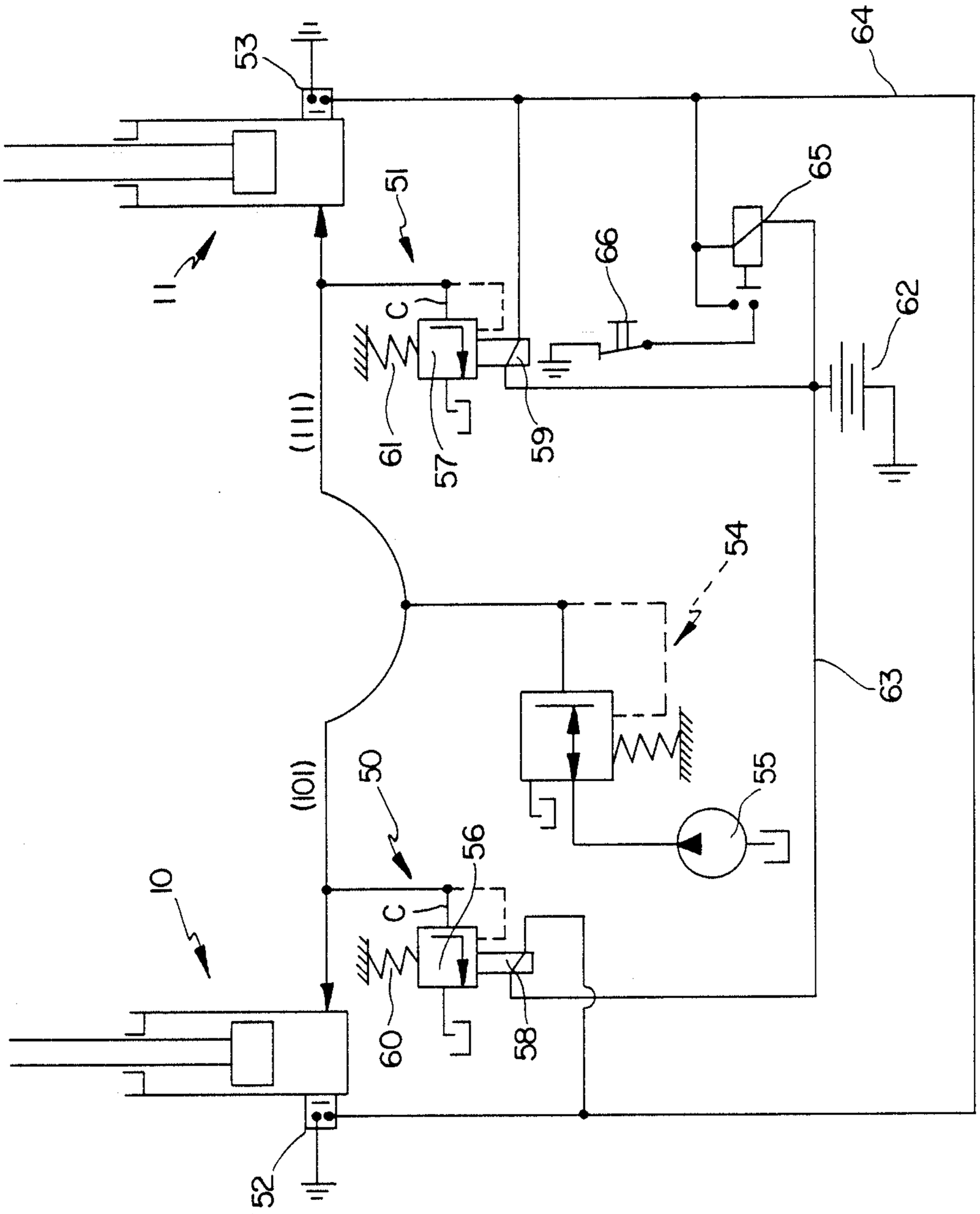

FIG. 5

ROLLER PRESS WITH A DEVICE FOR THE RELIEF OF THE PRESSURE ROLL

BACKGROUND OF THE INVENTION

The present invention refers to a roller press comprising a press roll and one or two cooperating pressure rolls, with particular application to a paper machine press section.

A roller press of this type is taught in Federal Republic of Germany Patent No. 959,702, corresponding to U.S. Pat. No. 2,855,829. It is there combined with a press section in a machine for the manufacture of paper and cellulose webs. In general, a roller press of this type can be used in wet presses and calenders and paper-making machines, as well as in plastic calenders and rolling mills.

In a known roller press or plant for the production of paper and cellulose webs, there is a pressure roll which is intended to be pressed against a fixed suction roll and there is a device for automatically lifting the pressure roll off the suction roll. Such lift occurs when the pressure prevailing in the suction line of the suction roll exceeds a given working pressure during the operation of the roller press, i.e. the required vacuum is no longer present in the suction line. The pressure roll is connected with a pressure cylinder which is finally activated when drying of the web of paper is no longer assured.

Brief variations in pressure are not recognized or responded to in the known design. In particular, disturbances on the suction roll which are limited in space are not recognized since measurements of the amount of air in the suction lines are too inaccurate for recognizing such deviations. For instance, entrained foreign bodies or folded regions of a pulp drainage felt, which are traveling through the press nip between the suction roll and the pressure roll, go unrecognized. For dependable operation of such a roller press and for the protection of the expensive roll coverings and pulp drainage felts, it is important that even brief, minor disturbances be rapidly and dependably recognized.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a roller press in which even relatively small disturbances are recognized, preferably rapidly. Another object is that as a result of these recognized disturbances, the press nip is immediately relieved of load over its entire width and, if necessary, the nip may also be opened.

The roller press of the present invention is shown in two embodiments, one that works hydraulically with working fluid and the other that is electrically operated. In all embodiments, the roller press includes a press roll. Means fix the press roll in position, but enable it to rotate. At least one pressure roll is arranged parallel to the press roll. The press and pressure rolls have respective surfaces that press against each other.

A plurality of positioning cylinders is associated with each of the pressure rolls for displacing the pressure roll with respect to the press roll so that the surfaces press together or move apart in a direction transverse to the axis of the pressure roll. There are operating means connected with each of the positioning cylinders for operating the cylinders to separate the pressure roll from the press roll as a result of a disturbance in the pressure at any of the positioning cylinders. That disturbance would occur upon some anomaly in the press nip.

That operating means comprises a respective safety valve connected with each positioning cylinder. The safety valve is operated by the respective positioning cylinder to a valve open condition for relieving pressure in the positioning cylinder upon the disturbance in the press nip. Connecting means functionally connect all of the safety valves with each other. Upon an increase in the pressure in one positioning cylinder, which causes the opening of its respective safety valve, all of the safety valves correspondingly move to the open condition so that all the pressure cylinders are relieved.

In one preferred embodiment, there are two of the pressure rolls. Each of the pressure rolls has a respective plurality of the positioning cylinders, each provided with a respective safety valve. All of the safety valves for all of the pressure rolls are connected together for relieving pressure if the pressure increases in any of the positioning cylinders.

In one embodiment, the safety valves have a fluid connection to the respective positioning cylinder and are operated by over-pressure in the positioning cylinder. In another embodiment, all the safety valves are electrically operable. Over-pressure in any positioning cylinder operates the valve electrically to the valve open pressure relief condition. All of the safety valves are here electrically connected to each other to operate together.

There is a main control valve connected with a source of working fluid which pumps the positioning cylinders to operate and that valve is also connected with the positioning cylinders of each respective pressure roll and with the respective safety valves of the respective pressure rolls. Closing of the main control valve from the source of working fluid prevents the passage of working fluid to the positioning cylinders and thereby triggers the closing of the safety valves to the non-relief conditions. There are closing means in the safety valves for closing the safety valves, upon the closing of the main control valve against flow of working fluid from the main control valve to the safety valves.

Where the pressure roll is above the press roll, the pressure roll rests with its own weight upon the press roll. The safety valve is connected with the respective positioning cylinders for causing the positioning cylinders to raise the pressure roll off the press roll.

The safety valve comprises a valve housing having a cylindrical chamber in it in which the valve body is movable. The valve body has opposite first and second active surfaces and there is a first pressure space above the first surface and the second pressure space below the second surface. The first pressure space is connected with the positioning cylinder to be acted upon directly by the pressure in the positioning cylinder. The second pressure space communicates with the positioning cylinder through a throttle. A spring acts upon the valve body for moving the valve body in the same direction as the pressure applied to the second surface of the valve body.

The connecting means between the various safety valves comprises a signal line connected to the second pressure space of every safety valve for connecting the second pressure spaces, whereby relief of the second pressure space of one valve relieves the second pressure space of all of them. An outlet relief connects to any one of the second pressure spaces, whereby relief of one pressure space relieves all. The valve bodies are ar-

ranged so that an increase in the pressure in one of the positioning cylinders moves the respective valve body for that cylinder to the position for relieving the pressure in the respective second pressure space and through the signal line connects all of the second pressure spaces for relieving them. The valve bodies are further designed so that upon shifting of the valve bodies upon relief of the second pressure spaces, the valve bodies have a further connection to the respective first pressure spaces.

The return spring has a force adjusted so that at a predetermined pressure in the positioning cylinder, the first and second active surfaces are in equilibrium with the respective safety valve in the valve closed, non-relieving position. The ratio of the first and second active surfaces is in the range of about 1.02 to 1.2 for the first active surface to 1 for the second active surface.

The first pressure space in the safety valve has a first outlet while the second pressure space has a second outlet. These outlets are arranged and dimensioned relative to each other and to the valve body that after relief of the working pressure in the second pressure space, the first outlet from the first pressure space is opened to an extent that the pressure acting on the first pressure surface is equal to the force being exerted by the return spring.

The valve housing of the safety valve contains a valve body that is actually comprised of two closed cylinders, with each of the cylinders having one of the active pressure surfaces defined on it. A first inlet into the valve housing communicates into the first pressure space while the second valve inlet into the valve housing communicates into the second pressure space. The throttle comprises a throttle line between the first and second inlet bores. The housing also has outlet bores from the first pressure space and from the second pressure space for communicating to the outlet relief. In particular, the first cylinder comprises a hollow shell and the second cylinder also comprises a hollow shell and the communications from the first and second cylinders to the respective outlets is through openings through the respective hollow shells.

In the alternate electrical embodiment, each of the safety valves comprises an electromagnetically actuated valve which is normally closed in a first operating position and which communicates with the positioning cylinder and also with a relief for pressure. The safety valve has one operating position in which it is closed against relieving pressure from the positioning cylinder to the outlet relief. The safety valve has a second position which connects the positioning cylinder to the outlet relief for relieving pressure in the positioning cylinder. A pressure switch electrically connects the safety valve and is operatively connected with the positioning cylinder. Upon an increase of pressure in the positioning cylinder, the pressure switch is operated for operating the safety valve to switch between the first closed position and the second pressure relief position.

An electric relay electrically connects all of the safety valves and is switched to operate by the signal which switches any of the safety valves from their first to their second positions. The relay includes a switch for being reset for enabling the connected safety valves to be reset into their first positions.

Other objects and features of the present invention will become apparent from the following description of the preferred embodiments of the invention considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** diagrammatically shows a three-roll wet press;

FIG. **2** diagrammatically shows the hydraulic circuit for the three-roll wet press of FIG. **1**;

FIG. **3** diagrammatically shows one of the safety valves shown in FIG. **2**, in its second switch position;

FIG. **4** is a cross-section showing the structural development of one of the safety valves shown in FIG. **2**;

FIG. **5** diagrammatically shows a second embodiment of the hydraulic circuit for a two-roll press.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows a so-called three-roll wet press, for example, that shown in Federal Republic of Germany Patent No. 1,090,076, corresponding to U.S. Pat. No. 2,869,437. For reasons of clarity of the drawing, the drainage felts, the paper web to be dried as well as guide rolls, frame elements and other mechanical structural parts of the press are not shown.

The three-roll wet press **1** comprises a press roll **3**, which is mounted in a fixed position in stationary supports **2**, and two pressure rolls **4**, **5** which can be applied tangentially against the press. The longitudinal axes of the press roll **3** and the pressure rolls **4**, **5** lie in the same plane, and the pressure rolls lie on opposite sides of the pressure roll.

One pressure roll **4**, the lower one in FIG. **1**, is applied against the press roll **3** from below, in opposition to its weight, by a first pair of levers **6**, **7**. A second pressure roll **5** is applied against the press roll **3**, aided by its own weight, from above by a second pair of levers **8**, **9**. Each of the levers **6**, **7**, **8** and **9** is pivotally mounted in a fixed support at one end of the lever and is turnably connected at the other end of the lever to the respective ends of the pressure rolls **4**, **5**.

Respective positioning cylinders **10**, **11**, **12** and **13** actuate or move the individual levers **6**, **7**, **8** and **9**. The pressure rolls **4**, **5** are thereby pressed with the necessary pressing force against the press roll **3**. The pressing force between the pressure rolls **4**, **5** and the press roll **3** is determined by the working pressure in the respective positioning cylinders **10**, **11**, **12**, **13**.

Referring to FIG. **2**, each of the positioning cylinders **10**, **11**, **12**, **13** has a respective pair of inlets **101**, **102**; **111**, **112**; **121**, **122**; **131**, **132** for the working fluid, e.g. oil, which acts upon the piston top and the piston rod sides, respectively, of the respective operating or lift pistons. Fluid applied at the inlets brings the working pistons into the correct working position or to the correct pressing pressure. In the three-roll wet press **1** shown in FIG. **1** as well as in the two-roll press to be described with reference to FIG. **5**, each pressure roll has a positioning cylinder associated with each of its ends so that the pressing force, i.e. the working pressure, between press roll and pressure rolls can be precisely adjusted over the entire width of the roll section (length of the pressure roll).

The invention comprises associating a safety valve with each of the positioning cylinders through which an increase in pressure which is sensed in a positioning cylinder and which is due, for instance, to a disturbance in the press nip between one of the pressure rolls and the press roll, causes relief of the working pressure of this positioning cylinder and also of the other positioning cylinders.

Each positioning cylinder **10, 11, 12, 13** is associated with a respective lever **6, 7, 8, 9**, which acts on the ends of the pressure rolls in such a manner that the positioning cylinders **10, 11** correspond to the one pressure roll and the positioning cylinders **12, 13** to the other pressure roll.

FIG. **2** diagrams the hydraulic system of the three-roll wet press. The positioning cylinders **10, 11** are paired and **12, 13** are paired with each other. The paired cylinders have inlets **101, 111** and **121, 131**, respectively, connected in each case jointly to a main control valve **20** and **21**, respectively. Via the main control valves **20, 21**, the positioning cylinders **10, 11** and **12, 13** can be connected to oil pumps **22** and **23**, respectively, which provide the positioning cylinders **10, 11** and **12, 13**, respectively, with the required working pressure via their inlets **101, 111** and **121, 131**, respectively.

Each positioning cylinder **10, 11, 12, 13** has associated with it a respective safety valve **24, 25, 26, 27**, which is designed so that upon an increase in pressure in the corresponding positioning cylinder **10, 11, 12, 13**, i.e. upon the occurrence of excess pressure, the respective safety valve immediately relieves the pressure in its positioning cylinders **10, 11, 12, 13**. The safety valves **24, 25, 26, 27** of one press section are coupled so that an excess pressure in the corresponding positioning cylinder **10, 11, 12, 13**, which is sensed in one of the safety valves **24, 25, 26, 27**, is simultaneously conducted to all the other safety valves **24, 25, 26, 27** of the same press section. The other safety valves then also relieve the working pressure of the corresponding positioning cylinders **10, 11, 12, 13**. Excess pressure in one positioning cylinder **10, 11, 12, 13**, due, for instance, to a disturbance in the neighboring press nip, thus relieves all of the positioning cylinders of load. Referring to FIG. **1**, this means that the lower pressure roller **4** moves downward under its own weight and opens the press nip. If the upper pressure roll **5** is also to be lifted off the press roll, i.e. the upper press nip is to be opened, the corresponding positioning cylinders **12, 13** must be acted upon on the piston rod side. In addition, still other functions, such as, for instance, the stopping of the press drive, can be initiated by a work signal which is generated in one of the safety vales **10, 11, 12, 13** as a result of a condition of excess pressure.

The manner of operation and the structural development of a safety valve **24, 25, 25, 27** is now discussed. The safety valve **24** is typical of valves **25, 26, 27**. Valve **24** has two line connections a, b on its inlet side. It also has an axially movable valve body **30** schematically shown as vertically movable in FIG. **2**. On its outlet side, there are two connections **34, 35**. These are both connected to a relief line **33** which extends to an oil collecting pan. The movable valve body **30** has a first, larger end surface **A1** and a second, opposite, somewhat smaller end surface **A2**. The first end surface **A1** and the connection a are connected to the inlet **101** of the cylinder **10** and are therefore directly acted upon by the working pressure in that cylinder. The second, smaller end surface **A2** and the connection b are also connected to the inlet **101** of the cylinder **10**, but via a throttle **31**. The dashed arrow line from line **36** to surface **A2** shows how surface **A2** is acted upon. The second end surface **A2** is, in addition, acted on by the force of a spring **32**. In the static condition, i.e. as long as no working fluid or oil flows through the throttle, the pressure on the surfaces **A1** and **A2** is the same.

In FIG. **2**, the valve bodies **30** of the safety valves **24, 25, 26, 27** are shown against the upper stop. Thus, the communications to the relief line **33** are interrupted, i.e. closed. To couple the safety valves **24, 25, 26, 27** of a press section to each other, the second end surfaces **A2** of all safety valves **24, 25, 26, 27** are connected to each other via signal lines **36**. In the event of an impermissible increase in the working pressure in one of the positioning cylinders, for example cylinder **10**, the increased pressure on the end surface **A1** of the safety valve **24** displaces the valve body **30** in the "open" direction toward the bottom in FIG. **2**. This relieves the pressure present at the smaller end surface **A2** of the valve body of the safety valve **24** by connecting the two connections b and **35**. The signal line **36** at the valve **24** is relieved also through such connections. At the same time, the smaller end surfaces **A2** of the other safety valves **25, 26** and **27** are also relieved via the connected signal lines **36**, so that the valve bodies of the other valves also shift down and the other valves are also open. As a result, the respective inlets **101, 111, 121, 131** of all of the valves are connected to the relief lines **33** on all positioning cylinders **10, 11, 12** and **13**.

The switchable connections between the pressure-side connections a, b and the outlet-side connections **34, 35** are indicated by the solid arrows in the valve body **30**. Due to excess pressure or because of the difference in pressure on the first end surface **A1** and the second end surface **A2**, if the valve body **30** is displaced against the force of the spring **32**, out of the equilibrium position and toward the bottom in the drawing, then the first passage b-**35** corresponding to the lower arrow is opened first, which permits the pressure on the second end surface **A2** to drop toward zero. The valve body **30** is then pushed down further and with increased force so that the second passage a-**34** corresponding to the upper arrow also opens, while the first passage b-**35** remains open.

The force of the spring **32** is so adjusted that, slightly below the threshold or difference value which triggers the start of the switching process of a safety valve **24, 25, 26, 27**, the setting forces acting on the two end surfaces **A1** and **A2** are in equilibrium with each other. The force of the spring **32** corresponds in this case to the product of the difference in area of the end surfaces **A1** and **A2** times the working pressure. With this adjustment of the force of the spring **32**, the valve body **30** of each of the safety valves **24, 25, 26, 27** "floats" in an intermediate position, which is still closed. The valve body thus has a very short reaction time, i.e. switching time. In order to be able to use small spring forces, the ratio between the two end surfaces (effective surfaces) **A1** and **A2** is only slightly greater than 1, and preferably between 1.02 and 1.2 for the surface **A1** to 1 for the surface **A2**.

Once any safety valve **24, 25, 26, 27** has opened, the communication between the connection a of the working pressure and the relief line **33** remains open only to such an extent that the residual force acting on the first end surface **A1** corresponds to the force of the spring **32**. By this structural solution, the connection of the signal line **36** to the relief line **33** is finally held open. Thus, there is no possibility that the working pressure at the positioning cylinders **10, 11, 12, 13** will unintentionally build up again. This is necessary to assure that the working pressure does not build up before the cause of the increase in pressure has been recognized and eliminated.

In order to reach the normal working condition again, i.e. have working pressure available at all positioning cylinders **10, 11, 12, 13**, the main control valves **20** and **21** must first be brought into their zero positions. In this way, the pressure acting on the first end surface **A1** is brought to zero and the valve bodies **30** of the safety valves **24, 25, 26, 27** are pushed by the force of their springs **32** into the closed position until the valve bodies **30** again lie against their upper end stops. The main control valves **20, 21** can now be opened, i.e. the positioning cylinders **10, 11, 12, 13** can again be acted upon by working pressure.

The through switched condition of the safety valve **24, 25, 26, 27** will be described with reference to FIG. **3**. In this switching condition, both the inlet a on the working pressure side and the second inlet b coupled via the throttle line **31** are in communication with the relief line **33**. The connection of the inlet b to the relief line **33** is entirely open. Between the working pressure line a and the relief line **33**, there is a throttled connection, since the force of the spring **32** maintains the equilibrium. This means that the pressure liquid conveyed by the oil pump **22** or **23** flows in part over the working pressure side connection a and in part over the throttled connection b to the relief line **33**.

The structure of a safety valve **24, 25, 26, 27** is explained with reference to FIG. **4**, which is a longitudinal section through the valve. The safety valve includes a valve block **37** within which the valve body is contained for axial movement within a central bore **38**. In FIG. **4**, the valve body **30** is in so called "floating" equilibrium, which it assumes when the working pressure is slightly below the predetermined trigger or limit value set. This limit value is preferably selected so that the difference between the pressure at which the valve body lifts off the upper end stop and at which the pressure relief commences is, for instance, 5% of the maximum permissible pressing pressure between pressure roll and press roll.

The valve body **30** is actually comprised of two cylinders **39, 40**, each of which is closed at one side so that they together define two closed end surfaces, which correspond to the active surfaces **A1** and **A2**, respectively, of the safety valves **24, 25, 26, 27** in accordance with FIGS. **2** and **3**, resting against each other. The "upper" cylinder **39** has a larger diameter **A1**. There is access from the open side of the upper cylinder **39** to the working pressure line a. The "lower" cylinder **40** has a smaller diameter **A2**. There is access from the open side of the lower cylinder **40** to the inlet b which is connected via the throttle line **31** to the working pressure line a.

In another embodiment (not shown), the two cylinders **39, 40** can also be combined into a single piece valve body **30**. Instead of the throttle line **31** arranged in the housing **37**, a coaxial throttle bore can then be provided in the valve body **30**.

The lower cylinder **40** is resiliently mounted via a spring **32**. The force of the spring **32** is adjustable from the outside by a bolt **41** which is axially displaceable coaxial to the central bore **38**. The bolt **41** has a support disk **42** which corresponds to the diameter of the spring **32** and which can be displaced axially via a bolt **43** to adjust the spring **32** to the predetermined spring force.

Both cylinders **39, 40** have respective openings **39'**, **40'** distributed over their peripheries. Paths to the relief line **33** can be opened through the openings **39'**, **40'**. For forming these paths, two annular spaces **34, 35** are worked into the valve block **37** for the connections. Both of the spaces **34, 35** have a connection to the relief line **33**, as shown in FIGS. **2** and **3**. The arrangement of the annular spaces **34, 35** and their association with the openings **39'**, **40'** is such that, upon an axial movement in the direction of arrow X of the valve bodies **30**, i.e. of the two cylinders **39, 40**, first the openings **40'** of the cylinder **40** having the smaller effective-surface/end-surface **A2** are connected to the lower annular space **35**. Upon further displacement of the valve bodies **30**, the connecting line between the working pressure line a and the relief line **33** then also opens via the openings **39'** while the connection of openings **40'** at space **35** remains.

The interaction with respect to the spring force and the consequence of the opening of the line paths a and b to the low pressure line **33** has already been explained with reference to FIGS. **2** and **3**.

A second embodiment of the invention is explained below with reference to a two-roll press shown in FIG. **5**. In contrast to the embodiments of FIGS. **2, 3** and **4**, FIG. **5** concerns an electrical system. It has the advantage from the start that the propagation of the signal is very much faster, which can be important with respect to rolls having a width of up to ten meters.

For each pressure roll, there are two positioning cylinders **10, 11**, each having a respective associated electromagnetic safety valve **50, 51**. To transmit a signal in the event that the working pressure in one of the positioning cylinders **10, 11** increases to an impermissible extent, a respective electric pressure sensing switch **52, 53** is arranged on each positioning cylinder **10, 11**.

If one of the pressure switches **52, 53** closes as a result of an impermissibly high pressure in its respective positioning cylinder **10, 11**, then the electromagnets of all safety valves **50, 51** are energized via the corresponding switch signal as a work signal when those valves are coupled with respect to the signal. At the same time, the safety valves **50, 51** are are thereby brought into an operating position which switches open a connection to a low-pressure connection, for instance of an oil collection pan.

Referring to FIG. **5**, each safety valve **50, 51** has an inlet connection c. These connections c are connected to the working pressure side connection of the positioning cylinders **10** and **11**, respectively, and, via a main control valve **54**, to an oil pump **55**. The safety valves **50, 51** comprise respective valve bodies **56** and **57**, which are held by the force of respective setting springs **60, 61** in a first closed pathway operating position. In this first operating position shown in the drawing, the connection to be switched by each valve body is closed.

The electromagnets **58, 59** may be supplied with electricity via electric line **63** from a voltage source **62**. The electromagnets **58, 59** are connected via a signal line **64** to each other and to the pressure switches **52, 53**. If either pressure switch **52, 53** is closed due to elevated pressure, then the electromagnets **58, 59** are energized. The valve bodies **56, 57** are then pushed (up in FIG. **5**) into their second open pathway operating position against the setting springs **60, 61**. As a result, the inlet connection a from the cylinders **10, 11** is connected to the lowpressure line. The working pressure at both positioning cylinders **10, 11** together thus drops to zero. Of course, the switching movement can also be reversed such that the electromagnets are energized in order to close the valves while they are cut off from

current to open the valves when there is an overload signal.

As already explained based upon FIG. 2, the working pressure must be prevented from again building up prematurely in an undesired manner. For this purpose, a holding circuit is integrated in the circuit, to assure that the safety valves **50, 51** remain in the open condition, which is their second operating position. This holding circuit comprises a relay **65** which is in parallel with the circuit of the electromagnets **58, 59** of the safety valves **50, 51** and can be so acted upon via a switch **66** which can be switched to ground potential that the electromagnets **58, 59** are energized and the valve bodies **56, 57** are pulled against the force of the setting springs **60, 61** into the first or closing operating position. Now working pressure can again be built up at the positioning cylinders **10, 11** via the main control valve **54**.

Although the present invention has been described in connection with a plurality of preferred embodiments thereof, many other variations and modifications will now become apparent to those skilled in the art. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

What is claimed is:

1. A roller press comprising:

a press roll;

means for fixing the press roll in position;

at least one pressure roll, arranged parallel to the press roll; the press and pressure rolls having respective surfaces for being pressed against one another; a plurality of positioning cylinders connected to each pressure roll for displacing the pressure roll with respect to the press roll, for separating the surface of the pressure roll off the surface of the press roll in a direction transversely to the longitudinal axis of the pressure roll;

operating means connected with each of the positioning cylinders; the operating means comprising a respective safety valve connected with each of the positioning cylinder for being operated by the respective positioning cylinder to an open condition of the safety valve for relieving the pressure in the positioning cylinder and for operating the cylinder to separate the pressure roll from the press roll upon a disturbance in the press nip between the press roll and the pressure roll which momentarily increases the pressure in any of the positioning cylinders; and

connecting means functionally connecting all of the safety valves with each other such that upon an increase in pressure in one positioning cylinder, which causes the opening of the respective safety valve, all of the safety valves are correspondingly moved to the open condition so that all of the pressure cylinders are relieved.

2. The roller press of claim **1**, comprising two of the pressure rolls, each arranged parallel to the press roll and each having a respective pressing surface engaging the surface of the press roll; each of the pressure rolls having a respective plurality of the positioning cylinders, each positioning cylinder being provided with a respective safety valve; all of the safety valves being functionally connected by the connecting means, such that upon an increase in pressure occurring in one of the positioning cylinders, the respective safety valve opening to relieve the pressure in the positioning cylinder, and the connection between the safety valves causing all of the other safety valves of all of the pressure rolls to open for relieving all of the positioning cylinders.

3. The roller press of claim **1**, wherein each of the safety valves has a fluid connection to the respective positioning cylinder, and the means connecting all of the safety valves comprise a working fluid connection between all of the safety valves.

4. The roller press of claim **1**, wherein each of the safety valves is electrically operable; an electrical power source is connected with each of the safety valves for operating them to a first, valve closed, non-relief position; upon an increase of pressure in one of the positioning cylinders, the respective safety valve is electrically operated to the valve open position for relieving the pressure in the respective positioning cylinder; and the connecting means electrically connect the safety valves such that upon movement of one of the safety valves to the valve open, relief condition, the other safety valves are moved to the valve open, relief condition.

5. The roller press of claim **1**, further comprising a main control valve connected with a source of working fluid and with the positioning cylinders of each respective pressure roll and with the respective safety valves of the respective pressure roll such that closing of the main control valve from the source of working fluid for preventing passage of working fluid to the respective positioning cylinders triggers the closing of the respective safety valves to the nonrelief condition, and closing means in the safety valves for closing the safety valves upon the closing of the main control valve against flow of working fluid from the main control valve to the safety valves.

6. The roller press of claim **1**, wherein the pressure roll rests with its own weight upon the press roll, and the safety valve being connected with the respective positioning cylinders for causing the positioning cylinder to raise the pressure roll off the press roll upon the occurrence of an increase in pressure in one positioning cylinder which is sensed by the respective safety valve of that positioning cylinder.

7. The roller press of claim **1**, wherein the safety valve comprises a movable valve body and a chamber containing the valve body and in which the valve body is movable; the valve body having a first active surface; the chamber including a first pressure space above the first active surface, the first surface being connected with the positioning cylinder for being acted upon directly by the pressure in the positioning cylinder; the valve body having an opposite second active surface of smaller surface area than the first active surface; the chamber including a second pressure space above the second active surface; and a spring for acting upon the valve body for moving the valve body in the same direction as pressure applied to the second surface of the valve body;

the second pressure space being also connected to the working pressure of the positioning cylinder and a throttle for that connection being disposed between the positioning cylinder and the second pressure space;

the connecting means comprising a signal line connected to the second pressure space of every safety valve for connecting the second pressure spaces of all of the safety valves to each other, whereby relief of the second pressure space of one of the safety valves relieves the second pressure space of all of the safety valves;

an outlet relief connectable to any of the second pressure spaces; the valve bodies being arranged such that an increase in the pressure in one of the positioning cylinders moves the respective valve body for that cylinder to the position for relieving the pressure in the respective second pressure space and, through the signal line connecting all of the second pressure spaces, for relieving all of the second pressure spaces, and the valve bodies being further comprised such that upon shifting of the valve bodies upon relief of the second pressure spaces, the valve bodies having a further connection to the respective first pressure spaces.

8. The roller press of claim **7**, wherein the spring has a force adjusted so that at a predetermined pressure in the positioning cylinder, the first and the second active surfaces are in equilibrium with the respective safety valve in the valve closed, non-relieving position.

9. The roller press of claim **8**, wherein the ratio of the first and the second active surfaces is in the range of about 1.02 to 1.2 for the first active surface to 1 for the second active surface

10. The roller press of claim **8**, wherein the first pressure space for the safety valve has a first outlet and the second pressure space for the safety valve has a second outlet, the first and second outlets being so arranged and dimensioned relative to each other and to the valve body of the safety valve that after relief of the working pressure in the second pressure space, the first outlet from the first pressure space is opened to an extent that the pressure acting on the first pressure surface is equal to the force being exerted by the spring.

11. The roller press of claim **8**, wherein the safety valve comprises a valve housing having a bore through it and the movable valve body in the bore comprises two cylinders movable through the bore, the cylinders being closed, such that one closed cylinder in the bore defines the first pressure space and the other closed cylinder in the bore defines the second pressure space, and the first and second cylinders are movable together axially in the bore; the spring engaging the cylinders in the bore;

a first inlet into the valve housing for communicating into the first pressure space; a second inlet into the valve housing for communicating into the second pressure space; the throttle comprising a throttle line between the first and second inlet bores, and the first inlet bore being directly connected with the respective pressure cylinder while the second bore is connected with the pressure cylinder through the throttle and the second bore is also connected to the signal line;

a first outlet bore positioned for communicating with the first pressure space for leading to the outlet relief, and a second outlet bore in the valve housing for communicating with the second pressure space and connecting the second pressure space to the outlet relief.

12. The roller press of claim **11**, wherein the valve body includes a respective first annular space in the valve body connectable with the relief, the first annular space being placed so that upon axial movement of the first valve body cylinder under the influence of pressure from the positioning cylinder following relief of the second pressure space, the first pressure space communicates to the first annular space;

a second annular space in the valve housing and connected with the relief and so positioned in the valve housing that upon movement of the second cylinder following relief of the second pressure space, the second cylinder moves to communicate the second pressure space into the second annular space for relief of the second pressure space through the relief.

13. The roller press of claim **12**, wherein the first cylinder comprises a first hollow shell closed on the side toward the second cylinder and opened on the other side for defining the first pressure space and above the first shell; the second cylinder comprises a second hollow shell, closed on the side toward the first cylinder and opened on the other side for defining the second pressure space in and above the second shell; the communication from the first cylinder to the first annular space is through the first shell defining the first pressure space, and the communication from the second pressure cylinder to the second annular space is through the second shell defining the second pressure space.

14. The roller press of claim **4**, wherein each of the safety valves comprises an electromagnetically actuated valve which is normally closed in a first operating position and which communicates with the positioning cylinder and also with a relief for pressure, the safety valve having one operating position in which it is closed against relieving pressure from the positioning cylinder to the outlet relief; the safety valve having a second operating position which connects the positioning cylinder to the outlet relief for relieving the pressure in the positioning cylinder;

a pressure switch electrically connected with the safety valve and being operatively connected with the positioning cylinder such that upon an increase of pressure in the positioning cylinder, the pressure switch is operated for operating the safety valve to switch between the first, rest, closed condition into the second, working, pressure relief condition; and each of the safety valves being connected by the connecting means such that all of the safety valves are operated together to the second, working, relief position when one of the safety valves is operated to that position.

15. The roller press of claim **14**, further comprising an electric relay electrically connected to be switched by the signal which switches any of the safety valves from the first to the second positions, and which is connected for holding all of the safety valves in the second positions, the relay including a switch for being reset for enabling the connected safety valves to be reset to the first positions thereof.

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